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The Mountain Brushtail Possum (*Trichosurus caninus* Ogilby): Disseminator of Fungi in the Mountain Ash Forests of the Central Highlands of Victoria ?

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Abstract

Faeces collected from the Mountain Brushtail Possum (*Trichosurus caninus* Ogilby) at a forest site in the Central Highlands of Victoria contained fungal spores. Some spores were from hypogeal (underground-fruiting) fungi that form a symbiotic mycorrhizal relationship on the roots of a variety of trees and shrubs. When in symbiosis, these fungi absorb nutrients and water from the soil and donate them to the host plant, and protect its root system from deleterious root pathogens. Mycorrhizal fungi are thus integral to the survival, establishment and growth of plants. The possible functional role of *T. caninus* in dispersing the spores of mycorrhiza-forming fungi needs to be recognized formally in management practices designed to conserve the species in areas subject to land-uses such as logging. The conservation of *T. caninus* may be particularly important in the mountain ash forests of Victoria because other ground-dwelling mycophagists such as bandicoots and potoroos are rare or absent.

Introduction

The Mountain Brushtail Possum, *Trichosurus caninus,* is a species of arboreal marsupial that is largely confined to forest habitats in eastern Australia (How 1983; Lindenmayer *et al.* 1990). It is common in the montane ash forests of the Central Highlands of Victoria (Lindemayer 1989) where the major eucalypt species are Mountain Ash (*Eucalyptus regnans*) and Alpine Ash (*E. delegatensis*) (Lindenmayer *et al.* 1991). Despite its status within this region, the general ecology of *T. caninus* remains poorly understood although there have been studies of its diet (Seebeck *et al.* 1984) and habitat requirements (Lindenmayer *et al.* 1990).

Seebeck *et al.* (1984) found that fungi was an important seasonal component of the diet of *T. caninus,* but did not specify which species were consumed. Here, we describe for the first time some of the fungal taxa consumed by *T. caninus* at

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Cambarville, which was the site examined by Seebeck et al. (1984).

Methods

Study Site

The diet of *T. caninus* was examined at Cambarville (37°33'S latitude and 145°53'E longitude), in the Central Highlands of Victoria, south-eastern Australia. The area is characterised by mild summers and cool, wet winters. Further details of the climate, as well as the geology, soils, and vegetation of the study site have been described in detail by Seebeck *et al.* (1984). The predominant overstorey tree at Cambarville is *E. regnans.* In gullies, *E. regnans* is replaced by cool temperate rainforest dominated by Myrtle Beech *(Nothofagus cunninghamii),* Southern Sassafrass *(Atherosperma moschatum),* Silver Wattle *(Acacia dealbata),* Montane Wattle *(A. frigiscens),* Blackwood *(Acacia melanoxylon)* and Mountain Hickory Wattle *(Acacia obliquinerva).* Ground vegetation includes several species of ferns and herbaceious plants (Seebeck *et al.* 1984). Large decaying logs are abundant on the forest floor.

Trapping and Faecal Analysis

Trichosurus caninus was trapped during June 1992 in a 14 ha area at Cambarville, using wire cage traps baited with apple. Faecal pellets were collected from the floor of the traps on the first night an individual was captured and stored at 0°C until analysis.

Faecal pellets were thawed and macerated using a pestle and mortar, to which was added a small quantity of 70% ethanol. Distilled water was then used to wash the slurry through a sieve with mesh size of 0.125 mm x 0.125 mm. The resulting suspension was then left to settle for at least 24 hours. A small portion of the remaining sediment was extracted and placed on a microscope slide. A drop of Melzer's reagant (McIntyre and Carey 1989) and a drop of glycerol were then added to the slide and a coverslip placed over the entire suspension. The suspension was examined using a light microscope (X 1000 magnification).

Where possible, spore types were identified to species using the descriptions of Beaton and Weste (1982; 1984) and Beaton *et al.* (1984 a; 1984 b; 1985 a; 1985 b; 1985 c; 1985 d). However, most of the spores were placed into a category called 'other' (Table 1) because they did not agree with any known hypogeal taxa. Most spores in the 'other' category were presumed to come from epigeal (above-ground) fruiting bodies, although some may have come from hypogeal species yet to be formally described. The relative abundance of all spore types in each of 20 fields was assigned to one of the following categories: 1 = sparse, one or two spores; 2 = uncommon, three to five spores or; 3 = common, more than five spores present in the field of view. With the exception of the 'epigeal' category, individual spore types seldom exceeded more than seven or eight spores in any field of view. For all the samples, the percentage occurrence of each spore type was calculated according to the methods of Bennett and Baxter (1989) for all samples. These values were added, then divided by 15 (the total number of samples), to derive the average percentage occurrence of that spore type.

Results

Five adult male and ten adult female *T. caninus* were trapped at Cambarville during June 1992. Faecal samples were taken from all the animals caught.

A total of ten fungal taxa (genera and species) was identified from the faeces of *T. caninus* (Table 1). The most common taxa identified were *Thaxterogaster* sp. and *Chamonixia vittatispora.* All other taxa identified had a percentage occurrence in samples of less than 1%. Most (75.1%) fungal spores could not be assigned to a genus or species, and were placed in the category 'other'. Of the ten taxa identified from spores, eight were from hypogeal basidiomycete fungi.

Discussion

The presence of spores of fungi in the faeces of *Trichosurus caninus* is consistent with the results of Seebeck *et al.* (1984) and confirms the partially mycophagous feeding habit of this species in the mountain ash forests of the Central Highlands of Victoria. Seebeck *et al.* (1984) established that *T. caninus* consume fungi throughout the year. However, it seldom constituted more than 10% of total matter in faeces, although reached a peak of approximately 25% during April (on a percentage occurrence basis). In this study, we did not attempt to identify spores of epigeal fungi in *T. caninus* faeces, although they probably represented the bulk of spores which we placed in the category 'other'. Although we did not identify any epigeal fungi at the study site, a number of taxa were seen and included agarics, cup-fungi and boletes. Also of relevance, Seebeck *et al.* (1984) noted that individual *T. caninus* sometimes eat epigeal basidiomycete fungi, but did not identify these fungi to species level. Future studies should attempt to identify the species of epigeal fungi eaten by *T. caninus* so that the foraging behaviour of the species are better understood.

Table 1: Average percentage (%) occurrence of fungal taxa identified from spores in faeces of *Trichosurus caninus* collected in June 1992 at Cambarville, Victoria.

Species	Average % Occurrence
Ascomycetes	
Jafneadelphus sp.	0.6
Basidiomycetes	
Gasteromycetes	
Chamonixia vittatispora	7.7
Hydnangium sp. (U)	0.7
Hymenogaster nanus	0.7
H. zeylanicus	0.3
Mesophellia sp.	0.3
Thaxterogaster sp. 1	13.3
Thaxterogaster sp. 2	0.6
Stephanospora flava	0.4
Zygomycetes	
Endogonaceae	
Endogone sp. (spore walls double layered)	0.3
Other	75.1

Fruiting habit was either hypogeal or sub- hypogeal, except for *Jafneadelphus* sp. which was epigeal. The 'other' category refers to miscellaneous spore types that could not be attributed to any hypogeal taxa yet described. Many of the spores in the 'other' category were probably epigeal Ascomycotina and Basidiomycotina taxa. (U) indicates uncertainty in identification of that genus.

Our results and those of Seebeck *et al.* (1984) indicate that *T. caninus* eats less fungi than ground-dwelling mammals such as potoroos (Guiler 1970; Bennett and Baxter 1989; Scotts and Seebeck 1989), bandicoots (Quin 1985; Claridge *et al.* 1991) and native rats (Cheal 1987). Leaf tissue from a variety of plants is a more important component of the diet of *T. caninus* (Seebeck *et al.* 1984).

Some of the spores identified in *T. caninus* faeces were from the sporocarps (fruiting-bodies) of hypogeal taxa. Like epigeal fungi, many hypogeal fungi are presumed to form a symbiotic mycorrhizal association with the roots of a variety of forest trees and shrubs (Trappe and Maser 1977; Beaton *et al.* 1985 d). For example, fungi in the genus *Mesophellia* that were identified in *Trichosurus caninus* faeces are known to establish ectomycorrhizal relationships on the roots of several eucalypt species (Dell *et al.* 1990), including *E. regnans* (Ashton 1976) which is the dominant species of tree at Cambarville. Within this obligate association, the fungus accumulates nutrients and water from the soil and donates them to its plant host (Harley and Smith 1983). It also protects the roots of the host from fungal pathogens such as *Phytophthora*. In return, the mycorrhizal fungus receives carbohydrates from the host plant (Hacskaylo 1973).

For most hypogeal fungi, dispersal by wind and water is negligible because the fruiting body, and hence the spores, are buried beneath the soil-litter interface. They rely on being excavated by mycophagous mammals, eaten and the spores dispersed in faeces as the animal moves throughout its home range (Trappe 1988). This contrasts with dispersal mechanisms of epigeal fungi that fruit above the ground, allowing for direct contact between the spore-bearing tissue and the surrounding atmosphere.

The presence of the spores of hypogeal fungi in the faeces of *Trichosurus caninus* suggests that it forages on the forest floor and actively excavates the soil-litter profile in search of sporocarps. This is consistent with trapping studies, where animals are regularly captured in traps set on the ground (Lindenmayer *et al.* 1991). *T. caninus* has also been detected on the forest floor and running along fallen logs during spotlighting surveys at Cambarville (Lindenmayer, unpubl. data).

It is possible that the seasonal fruiting patterns of hypogeal fungal sporocarps at Cambarville influences the seasonal foraging behaviour of *T. caninus*. A recent study in the coastal forests of south-eastern Australia, suggests that different species of fungi have different habitat requirements (Claridge *et al.* 1993). Some taxa inhabit predominantly ridges and slopes, while others are confined mainly to gullies. Species that occur in gullies tend to be ephemeral and more abundant during the wetter months, while those in other areas have adaptations that allow for their persistence in the soil regardless of seasonal climatic conditions. At these sites, mycophagous mammals such as the Long-nosed Potoroo *(Potorous tridactylus)* may alter seasonal foraging patterns to take advantage of seasonal changes in the relative abundance of different fungi (Claridge 1993). However, a major difference in the diets of *P. tridactylus* and *Trichosurus caninus*, is that the former feeds much more extensively on hypogeal fungi. Thus, movements of *T. caninus* are less likely to be directly influenced by the fungal food resource, although inclusion of hypogeal fungi in the diet suggests a deliberate search effort on behalf of *T. caninus*.

Mycorrhizal fungi are integral to the survival, establishment and growth of plants. If *T. caninus* is capable of spreading the spores of these fungi in its faeces, then its role in key ecological processes within the mountain ash forests may be more important than previously recognized. This may be important as other ground-dwelling mammals likely to fulfill this role in the ecosystem, such as bandicoots and potoroos, are either rare or absent. The importance of mycophagous mammals needs to be recognized formally in forest management and logging practices need to become more compatible with the conservation of species such as *T. caninus* (Lindenmayer 1992).

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